Military Return to Duty and Civilian Return to Work Factors Following Burns With Focus on the Hand And Literature Review

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Functional recovery and outcome from severe burns is oftentimes judged by the time required for a person to return to work (RTW) in civilian life. The equivalent in military terms is return to active duty. Many factors have been described in the literature as associated with this outcome. Hand function, in particular, is thought to have a great influence on the resumption of preburn activities. The purpose of this investigation was to compare factors associated with civilian RTW with combat injured military personnel. A review of the literature was performed to assimilate the many factors reported as involved with RTW or duty. Additionally, a focus on the influence of hand burns is included. Thirty-four different parameters influencing RTW have been reported inconsistently in the literature. In a military population of combat burns, TBSA burn, length of hospitalization and intensive care and inhalation injury were found as the most significant factors in determining return to duty status. In previous RTW investigations of civilian populations, there exists a scatter of factors reported to influence patient disposition with a mixture of conflicting results. In neither military nor civilian populations was the presence of a hand burn found as a dominant factor. Variety in patient information collected and statistical approaches used to analyze this information were found to influence the results and deter comparisons between patient populations. There is a need for a consensus data set and corresponding statistical approach used to evaluate RTW and duty outcomes after burn injury. (J Burn Care Res 2008;29:756–762)

The functional capacity of an individual is highly dependent upon use of his hands. Hand function has an impact on most activities a person performs throughout normal daily activities including work in the case of adults. In all aspects of military combat operations, use of ones hands is of utmost importance. After a severe burn, a patient's resultant functional recovery is oftentimes described as an outcome. In civilian life, a commonly investigated adult burn outcome is return to work (RTW). In military terms, the equivalent of civilian RTW is return to duty (RTD).

The recent military conflicts Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) began in October, 2001 from which casualties of various types have been sustained. All military service members with severe burns from any etiology are treated at the American Burn Association verified United States Army Institute of Surgical Research (USAISR) Burn Center located in Brooke Army Medical Center at Fort Sam Houston, TX.[1] Military patients receive their acute through long-term rehabilitation at the USAISR until their medical and physical status is evaluated and they are judged fit for RTD

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or are discharge from military service after a thorough medical evaluation process. As a result of OEF/OIF, a large number of U. S. service members have experienced hand burns to the extent that we became interested in the impact of hand burns on military patients RTD outcomes. The purpose of this research was to investigate previously published common variables associated with RTW in the civilian population and to compare these factors with RTD in a military population with a focus on the presence of hand burns. Historical information from the burn literature was used as a basis for comparison.

METHODS

With approval of the Brooke Army Medical Center Institutional Review Board, a retrospective review of medical records of service members burned during OEF/OIF and admitted to the USAISR Burn Center from March, 2003 through June, 2005 inclusive was performed. Retrieved information was based on 11 parameters previously reported for civilian burn populations and thought to have an influence on RTW/RTD. Data collected are listed in Table 1.

Demographics of the total patient population were determined. The total group was then subdivided and analyzed based on RTD status and hand burn status. Subsequent analysis was performed to determine parameters that impacted military personnel disposition of RTD or discharged from military service. We further used a convenience sample of patients with hand burns to specifically evaluate RTD outcome by using both the American Medical Association (AMA) Guide to Impairment[2] and the Disability of the Arm, Shoulder and Hand (DASH) assessment tool.[3] Patients with digit amputation and differing burn depths or other compounding factors were not separated out. Statistical analysis of the information was performed using Student's *t*-test, Fisher's exact probability test, Wilcoxon test and multivariate logistic regression (SAS version 9.1.3., SAS Institute, Cary, NC). A test result with an alpha level of ≤0.05 was considered significant.

Table 1. Patient parameters investigated

1. Age
2. Gender
3. Percent total body surface area burn (TBSA)
4. Percent full-thickness burn (FT)
5. Presence of inhalation injury
6. Injury severity score
7. Presence of associated trauma
8. Hospital length of stay
9. Intensive care unit (ICU) length of stay
10. Presence of hand burn
11. Disposition—return to duty/work (RTD/RTW)

RESULTS

During the time of the study, a total of 299 patients were admitted to the USAISR with burns from OEF/OIF. Of this number, 14 patients (4.6%) died from their injuries leaving 285 patients with RTD data to analyze. Demographic information for the surviving patient population is provided in Table 2. Of these 285 patients, 95% were male with a mean age of 26 years and the vast majority was burned by flame (96%). Mean TBSA burn was 12.1% with 5.7% full-thickness (FT) injury. Eleven percent (11%) of patients suffered an inhalation injury and 35.4% had associated trauma such as fractures, amputations, head injury or other extensive soft tissue damage. The mean injury severity score on admission was 8.5. Patients were hospitalized an average of 27.9 days with 101 patients (35%) spending approximately one fourth of that time in an intensive care unit. Two hundred twenty-one patients (77.5%) experienced a hand burn while 64 patients (22.5%) did not have a hand burn.

Of the 285 patients that survived, 190 patients (67%) overall were able to RTD while the remaining 95 (33%) patients were discharged from military service due to medical reasons. Table 3 shows a compar-

Table 2. Patient demographics (N = 285) values expressed as means ± standard deviations unless otherwise noted

Age (yrs)	26.0 ± 6.3 (range, 18.7–53.0)
Gender	F = 15 (5.2%)
	M = 270 (94.8%)
Burn type	96.0% Thermal
	3.5% Electrical
	0.5% Chemical
% Total body burn	12.1% ± 13.8 (range, <1– 97%)
% Full-thickness	5.7% ± 12.5 (range, 0–97%)
Inhalation injury	Yes = 11%
	No = 89%
Injury severity score	8.5 ± 10.1 (range, 1–75)
Associated trauma	Yes = 35.4%
	No = 64.6%
Hospital length of stay (d)	27.9 ± 46.7 (range, 1–502)
ICU length of stay (d)	7.4 ± 28.5 (range, 0–426)
Presence of hand burn	Yes = 77.5%
	No = 22.5%

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Table 3. Demographic information comparison RTD and N-RTD patients

Category	RTD (N = 190)	N-RTD (N = 95)	*P*
Age	26.0 ± 6.2	26.2 ± 6.6	NS
Gender			
Female	4.7%	6.3%	NS
Male	95.3%	93.7%	
% Total body burn	7.1 ± 6.6	22.1 ± 18.4	<.0001
% Full-thickness burn	1.8 ± 4.9	13.5 ± 18.3	<.0001
Inhalation injury			
Yes	3.7%	25.3%	<.0001
No	96.3%	74.7%	
Associated trauma			
Yes	27.9%	50.5%	.0002
No	72.1%	49.5%	
Hospital length of stay (d)	13.7 ± 14.6	56.2 ± 70.3	<.0001
ICU length of stay (d)	1.6 ± 5.7	18.9 ± 46.7	<.0001
Injury severity score	5.2 ± 6.4	15.0 ± 12.8	<.0001
Hand burn			
Yes	75.3%	82.1%	NS
No	24.7%	17.9%	

RTD, return to duty; *N-RTD*, no return to duty; *NS*, not significant.
Values expressed as means ± standard deviations unless otherwise noted.

Table 4. Hand burn compared to no hand burn

Category	Hand Burn (N = 221)	No Hand Burn (N = 64)	*P*
Age	26.1 ± 6.3	25.9 ± 6.4	NS
Gender			
Female	5.9%	3.1%	NS
Male	94.1%	96.9%	
% Total body burn	13.2 ± 14.9	8.5 ± 7.8	NS
% Full-thickness burn	6.4 ± 13.6	3.2 ± 7.3	NS
Inhalation injury			
Yes	10.4%	87.5%	NS
No	89.6%	12.5%	
Associated trauma			
Yes	35.3%	35.9%	NS
No	64.7%	64.1%	
Hospital length of stay (d)	30.3 ± 51.4	19.6 ± 22.9	NS
ICU length of stay (d)	8.6 ± 31.9	3.1 ± 8.1	.035
Injury severity score	8.9 ± 10.7	6.6 ± 6.9	NS
Return to duty			
Yes	64.7%	73.4%	NS
No	35.3%	26.6%	

NS, not significant.
Values expressed as means ± standard deviations unless otherwise noted.

ison of demographic variables between patients able to RTD and those who were not able to return to duty (N-RTD). Of the 10 variables associated with whether or not injured service members were able to RTD, seven variables were found to be statistically significant whereas age, gender, or the presence of a hand burn was not. Table 4 compares demographic information between patients with hand burns and those without hand burns. Seventy-eight of 221 patients (35.3%) with a hand burn and 17 of 64 patients (26.6%) without a hand burn were unable to RTD. Only days spent in intensive care unit was significantly different ($P = .035$) between the two groups. Most predictive of all variables for service members N-RTD were the presence of an inhalation injury, length of hospitalization and TBSA (Table 5).

Two hundred twenty-one (221) patients in the present study experienced a hand burn of which 99 (44.8%) had their hands formally evaluated for function at the time of discharge from the acute care setting. The patient subgroup who had a hand burn and a formal evaluation of functional use of their hands revealed that military personnel who were N-RTD had a mean AMA impairment rating of 43 and DASH score of 50 (Table 6); whereas military personnel who RTD had a mean AMA impairment rating of 19 and DASH score of 29. The differences between groups for both functional tests were found significant ($P < .001$).

DISCUSSION

RTW or, in the case of military personnel, RTD is a significant accomplishment for patients following severe burns. Predicting which patients have the best potential to resume their pre-burn vocational lifestyle is presently difficult but would be highly beneficial to know for, among other considerations, allocation of resources and treatment planning. In the burn literature, there are no less than 17 reports that have investigated 34 parameters associated with RTW (Table 7) in the civilian population.[4–20] The most frequently

Table 5. Multivariate logistic regression

Parameter	Odds Ratio (95% CI)	*P*
Age	0.98 (0.92, 1.03)	NS
% Full thickness burn	1.00 (0.92, 1.07)	NS
Gender	0.55 (0.15, 2.14)	NS
Hand burn	1.12 (0.5, 2.63)	NS
Intensive care unit stay (d)	1.01 (0.95, 1.08)	NS
Inhalation injury	3.80 (1.04, 14.45)	.04
Length of hospitalization (d)	1.03 (1.01, 1.06)	.001
% Total body surface area burn	1.08 (1.01, 1.15)	.02
Associated trauma	1.92 (0.92, 4.01)	NS

NS, not significant.
All patients disposition indicating odds of medical discharge. (N = 285 of which 95 were N-RTD and 190 were RTD).

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Table 6. Comparison of patient function scores

Test	Score	*P*
AMA impairment		<.001
N-RTD (N = 36)	43	
RTD (N = 63)	19	
DASH score		<.001
N-RTD (N = 36)	50	
RTD (N = 63)	29	

RTD, return to duty; *N-RTD*, no return to duty.

investigated parameter relative to RTW has been TBSA burn followed by an equal number of publications reporting on the contribution of age and FT burns. Except for the three parameters of skin grafting, treatment time and presence of a face burn where all reports agree as to the influence of each one of these parameters on patient RTW outcome, amongst the other studies there is division as to whether the other factors positively or negatively affect RTW, including the presence of hand burns.

Table 7. Literature review of parameters influencing return to work in civilians

Parameter (No. of Citations)	Reference(s)
Percent total body burn (12)	4–12, 14, 16, 20
Age (8)	5–9, 12, 14, 16
Percent full-thickness (8)	5–12
Hand burn (7)	4, 6–11
Employment status (6)	6–8, 11, 12, 14
Skin grafting (5)	9–12, 17
Psycho/social issues (5)	4, 8, 11, 14, 19
Gender (5)	5, 6, 12, 14, 16
Length of hospitalization (4)	8, 11, 12, 19
Marital status (3)	6, 12, 14
Ethnicity (3)	5, 12, 14
Face burn (3)	4, 7, 11
Treatment time (3)	5, 7, 9
Whole person impairment (2)	13, 18
Education level (2)	11, 12
Workers compensation/insurance (2)	11, 12
Burn type (2)	5, 15
Work type (2)	6, 9
Arm burn (1)	14
Leg burn (1)	14
Functional independence measure (1)	13
Out-patient rehabilitation (1)	12
Family satisfaction (1)	12
Self blame (1)	12
Litigation (1)	11
Self-assessment (1)	11
Foot burn (1)	11
Inhalation injury (1)	11
Functional independence (1)	11
Time since injury (1)	8
Pain (1)	8
Medical history (1)	6
Substance abuse (1)	6
Payment (1)	5

Of the studies that agree on factor influence, five document that skin grafting had a significant effect on increasing RTW time.[9–12,17] Similarly, three studies agreed that the length of time a patient remains under treatment has a significant impact on delaying time before RTW.[5,7,9] In three studies reporting on the influence of facial burns on RTW, surprisingly all concurred that having a face burn did not impact RTW.[4,7,11] Of the additional 15 factors where more than one investigator looked at a given parameter as listed in Table 7, outcomes are mixed as to the influence each parameter had on RTW including hand burns.

Seven studies have reported on the impact hand burns have in determining RTW.[4,6–11] Data are equally divided as to the effect of hand burns on RTW. Three of seven studies documented that hand burns did not influence RTW status[4,7,8] whereas another three studies documented that the presence of a hand burn negatively impacts patients' RTW.[6,9,10] The seventh study considering the influence of hand burns on RTW indicated that the mere presence of a hand burn had no effect; however, the authors also documented that patients' self-reported ability to use their hands to grasp and overall hand function were positively correlated with longer RTW.[11]

Comparing our results with these found in the literature, only one of the hand studies performed a regression analysis to study the influence of the various parameters. Using stepwise multiple regression analysis, Helm et al determined TBSA to be the strongest predictor of RTW followed equally by skin grafting and hand burn.[9] Our analysis shows TBSA, hospital days, and inhalation injury to be significant (Table 5). When length of stay was factored out of the regression model (data not shown), days spent in intensive care also became significant ($P = .03$).

In our patient population, the presence of a hand burn was not found to statistically predict RTD. One other study included military personnel as part of their investigation.[16] The study population used by Xiao and Cai contained eight military personnel in their cohort of 86 patients with 50% or more TBSA burns but did not segment a military subgroup out for differences in factors affecting RTD.

Chang and Herzog[4] reported that 95% of patients employed at the time of their injury were able to RTW. They further reported that the presence of hand burns did not influence RTW although there was a trend for patients with hand burns to take

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longer to RTW than patients without hand burns. A purpose of the investigation by Tanttula et al[7] was to establish factors delaying patients' RTW. These authors used the Kruskall-Wallis one-way analysis of variance to test for differences and the relationship amongst TBSA, FT injury, age, time of hospital treatment to RTW time and chi-square test of hand and facial burns. Their results showed that TBSA, FT burns and total treatment time negatively impacted RTW while age and a hand or face burn did not affect RTW. Dyster-Aas et al[8] reported using the Burn Specific Health Scale-Brief (BSHS-B) inventory on the disposition of 86 patients who were injured at work an average 9 years earlier. They found that the hand function domain of the BSHS-B was not a discriminating factor by Mann-Whitney *U*-test between their patients formerly working and those patients not working.

Bowden et al[6] reported on 155 patients who were employed at the time of injury and did RTW. Analysis used to determine statistical significance was not revealed. They documented TBSA, FT, age, type of work, and associated medical problems significantly delayed RTW. They also reported burns to the hands, especially where FT injuries were present, delayed RTW but did not state whether this finding was statistically significant. As previously mentioned, Helm et al[9] reported on the influence of hand burns on RTW at 8 months. They used a one-way analysis of variance for variables TBSA, hand burn, skin grafting to the hand, age, and occupational category. Their results indicated that patients with larger TBSA burn took longer to RTW; patients with bilateral hand burns took longer to RTW than if only one hand was involved; and patients with skin grafted hands took significantly longer to RTW than those patients who healed without skin grafting. Age of patients and occupational category were not significant. Covey et al[10] documented the influence that depth of hand burns in adults had on time to recovery. They did not correlate their findings specifically to RTW except to mention that any limitation in hand function influenced vocational activities.

Finally, Saffle et al[11] analyzed by *t* test, chi-square analysis and correlations 15 variables thought to influence RTW and found 10 variables significant. Part of their investigation included a hand burn questionnaire with responses from 236 patients working at the time of their injury. As previously noted, the presence of a hand burn did not significantly correlate with RTW but the patients' reported ability to use their hands did.

In the present study, TBSA as a significant factor affecting RTW agrees with nine other investigators.[4–7,9–11,14,20] Beyond TBSA, we found length of hospitalization to influence RTD which parallels others results.[11,12] We also found that inhalation injury experienced by military personnel in combat as an associated factor determining RTD. In the literature, only one other study included inhalation injury as a parameter and found it not to be significant.[11] Days spent in intensive care as a significant factor in the present study was not uncovered in any other study as factors investigated. Furthermore, we did not determine that the mere presence of a hand burn was statistically relevant for predicting injured military personnel RTD and adds to the mix of results as discussed earlier. This finding was of particular interest as patients who had severe hand and finger contracture universally resulted in a failure to RTD receiving a medical discharge from the Armed Forces.

In future research of this type, it will be important to investigate and report more detailed information associated with the parameters herein reviewed. For example, in the present study, we found inhalation injury related to medical discharge from military service. However, the results of pulmonary function tests were not factored into the determination and more than likely the outcomes of such tests might be more sensitive predictors. Similarly for the hand, tests to determine a patient's ability to functionally use his hand would be more informative than if the hand was involved as part of a total body burn. More definitive and exacting tests focusing on specific parameters should be done.

Of the 221 patients experiencing hand burns, we analyzed hand outcome data on a convenience sample of 99 patients. Table 8 compares demographic information between patient subsets as to whether they had hand outcome data collected. The two groups differed in total body surface are burn, associated trauma and hospital length of stay. These results indicate that patients with larger burns had a greater chance of being tested whereas those with associated trauma or longer lengths of stay were less likely to be tested.

Hand outcome data was collected and analyzed using the AMA Guidelines to Impairment and the Disabilities of the Arm, Shoulder and Hand (DASH) outcome measures[2,3] (Table 6). In both of the foregoing hand evaluation methods, lower scores indicate better outcome. When comparing the data based on functional tests, there was a significant difference between those who RTD and those who were ultimately medically discharged from military service by either scale. This finding supports the previous mention that more precise parameters need to be used to sort out real differences similar to what Saffle et al reported.[11] In our overall experience, it seems that patients with mild hand burns may have diluted the population

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Table 8. Comparison of patient groups tested and not tested

Category	Tested (N = 99)	Not Tested (N = 122)	*P*
Age	26.1 ± 6.9	26.0 ± 5.7	NS
Gender			NS
Female	5 (5.1 %)	8 (6.6%)	
Male	94 (94.9 %)	114 (93.4 %)	
% Total body burn	15.1 ± 13.1	11.6 ± 16.3	<.001
% Full-thickness burn	6.6 ± 10.3	6.3 ± 15.9	NS
Inhalation injury			NS
Yes	13 (13.1 %)	10 (8.2 %)	
No	86 (86.9 %)	112 (91.8 %)	
Associated trauma			.05
Yes	28 (28.3 %)	50 (41 %)	
No	71 (71.7 %)	72 (59 %)	
Hospital length of stay (d)	29.3 ± 34.1	31 ± 62.1	.008
ICU length of stay (d)	7.9 ± 13.8	9.3 ± 41.3	NS
Injury severity score	9.5 ± 10.2	8.6 ± 11.4	NS

NS, not significant.
Values expressed as means ± standard deviations unless otherwise noted.

pool giving the impression that hand burns are not a factor when patients with severe hand burns actually have a poor prognosis for RTD.

Bowden et al[6] previously recommended that future studies on the current topic should investigate and analyze a consensus set of parameters related to RTW as developed by the rehabilitation community. Beyond the 34 parameters listed in Table 7, Dyster-Aas et al insightfully suggests that early in recovery following hospital discharge, physical problems may predominate a patient's status whereas in the long-term, psychosocial issues dominate.[8] Therefore, there should be agreed upon time points for data collection. A limitation of our study is we determined patient status while they were receiving out-patient care. This timing may have been shortsighted indicating that a longer follow-up of patients may be beneficial. In addition, stratifying patients into groups based on TBSA and burn complexity may yield different results for all variables.

Another point for consideration when reporting employment outcomes is keeping separate and distinct employed patients injured on the job vs those working but not injured on the job, as injury on the job may affect compensation status and therefore influence RTW.[9,10] Likewise, prior employment status of individuals who get burned, eg, retirees or the unemployed, and who are successfully rehabilitated but remain unemployed should not be considered as statistical failures. Also, patients deemed unable to RTW or RTD should not be considered synonymous with being unable to work. There are instances where a job change or modification or retraining can occur for patients to achieve gainful employment. For examples, a construction worker who no longer is able to tolerate extremes of outdoor temperature following recovery from a severe burn may be perfectly able to make work assignments indoors where temperatures are controlled. Military combat personnel unable to safely function on the battlefield can be reclassified and reassigned to a different military occupational specialty in support of operations. Furthermore, there are examples of service members who have been medically discharged from the military but are presently gainfully employed in civilian life.

Lastly, as revealed in this literature review, many different statistical analyses have been used in the past based on the characteristics of the data collected. However, if a consensus data set was routinely collected, and an agreed upon statistical analyses was performed; this would lead to stronger and comparable information that would be more meaningful to all concerned.

CONCLUSION

In a military population, length of hospitalization, TBSA and the presence of inhalation injury were most strongly associated with a failure to RTD. Being able to associate burn factors of civilian RTW with military personnel RTD is unsettled. Different factors in different populations utilizing different statistical methods for analysis confound predictions. From our present investigation and in conjunction with the mixed results from previously cited studies, having a more reliable data set of predictors would better enable the interpretation of outcomes and improve care based on a more scientific approach to burn rehabilitation.

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